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Supplementary Materials for

Using the fast impact of anthropogenic aerosols on regional land temperature to constrain aerosol forcing

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This PDF file includes:

Supplementary Materials

Analysis for June to September

We repeat the analysis for June to September (JJAS), which is more commonly used for studying the Asian monsoon. In this case, NO_AERO underestimates the observed warming by ~27% over Europe, and overestimates by ~47% over Asia (Fig. S3). We also obtain an estimated global ERF of 1.7±0.7 W m^{-2} from LSAT change over Europe, and 1.2±0.8 W m^{-2} from LSAT change over Asia (Fig. S4). This shows that the results in the main text are rather robust with respect to the choice of months.

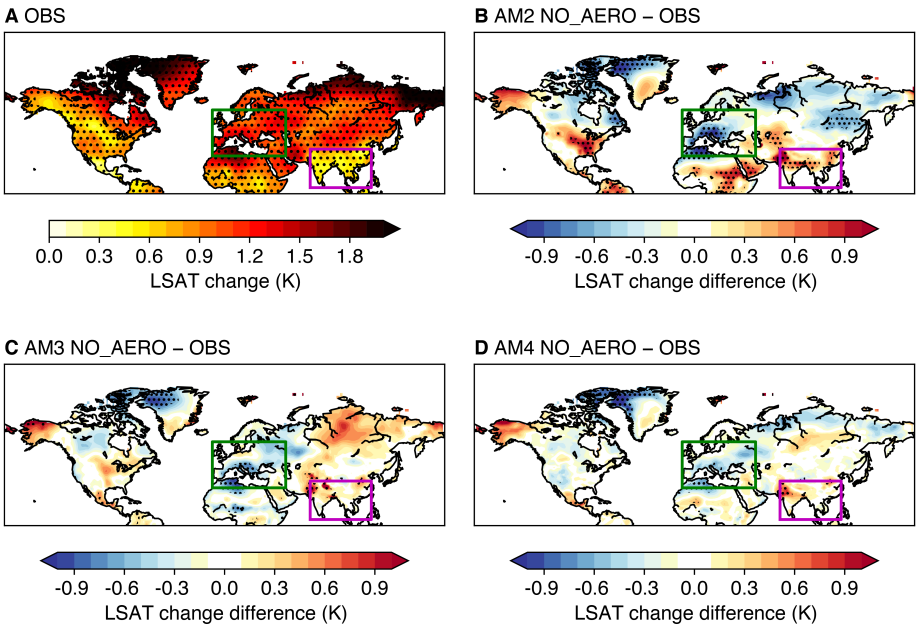

Fig. S1. Spatial patterns of LSAT changes. (A) Observed and (B) AM2, (C) AM3, and (D) AM4 NO_AERO simulated minus observed recent JJASON LSAT changes (2001-15 minus 1961-80). Stippling indicates where the differences are significant at the 90% confidence level. The green and purple rectangles denote Europe and Asia used for averaging, respectively.

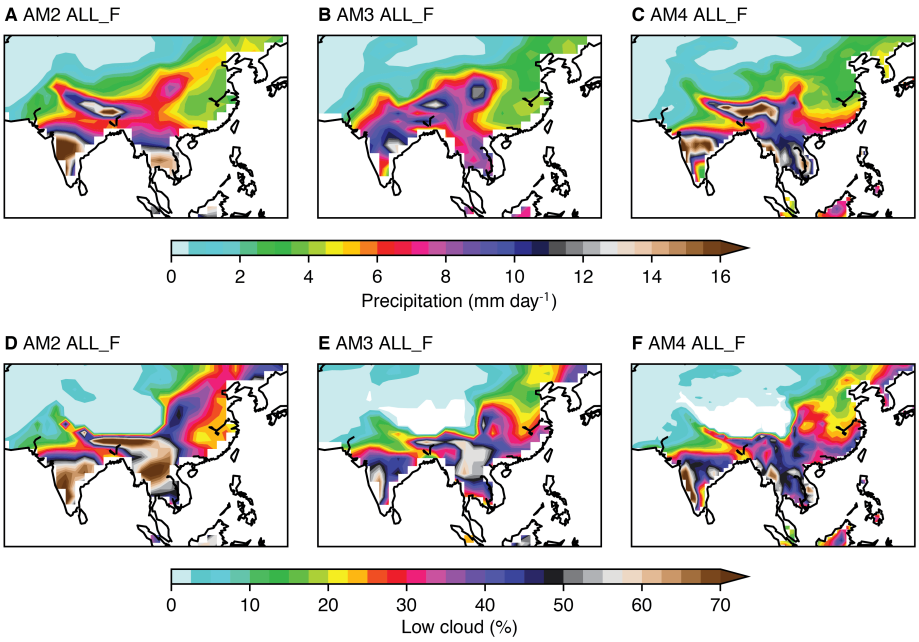

Fig. S2. Asian monsoon climatology. JJAS (A-C) precipitation and (D-E) low cloud amount averaged from 1961 to 2015 in (A,D) AM2, (B,E) AM3, and (C,F) AM4 ALL_F simulations.

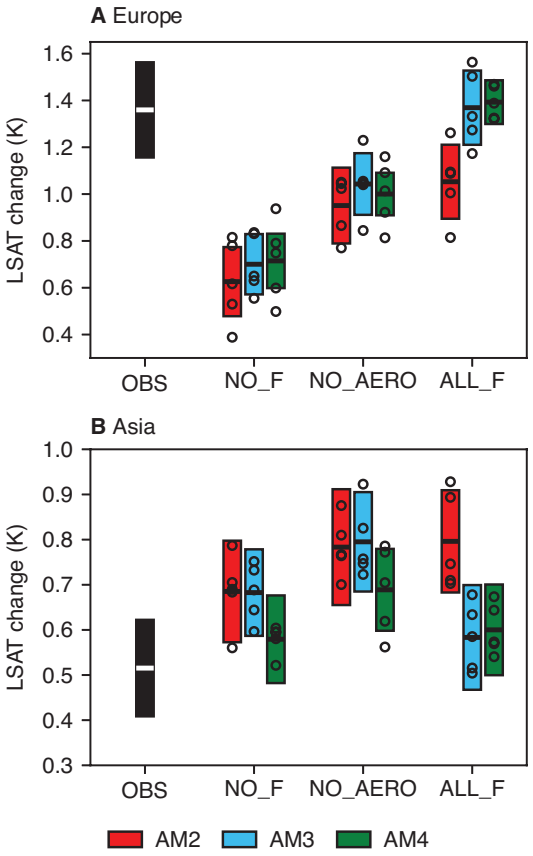

Fig. S3. **JJAS regional LSAT changes.** Observed and simulated recent JJAS LSAT changes (2001-15 minus 1961-80) over Europe (A) and Asia (B). The boxes denote the mean changes (the center lines) and 90% confidence intervals (see Materials and Methods). The observations are in black, AM2 in red, AM3 in blue and AM4 in green. The black open circles represent the individual ensemble members.

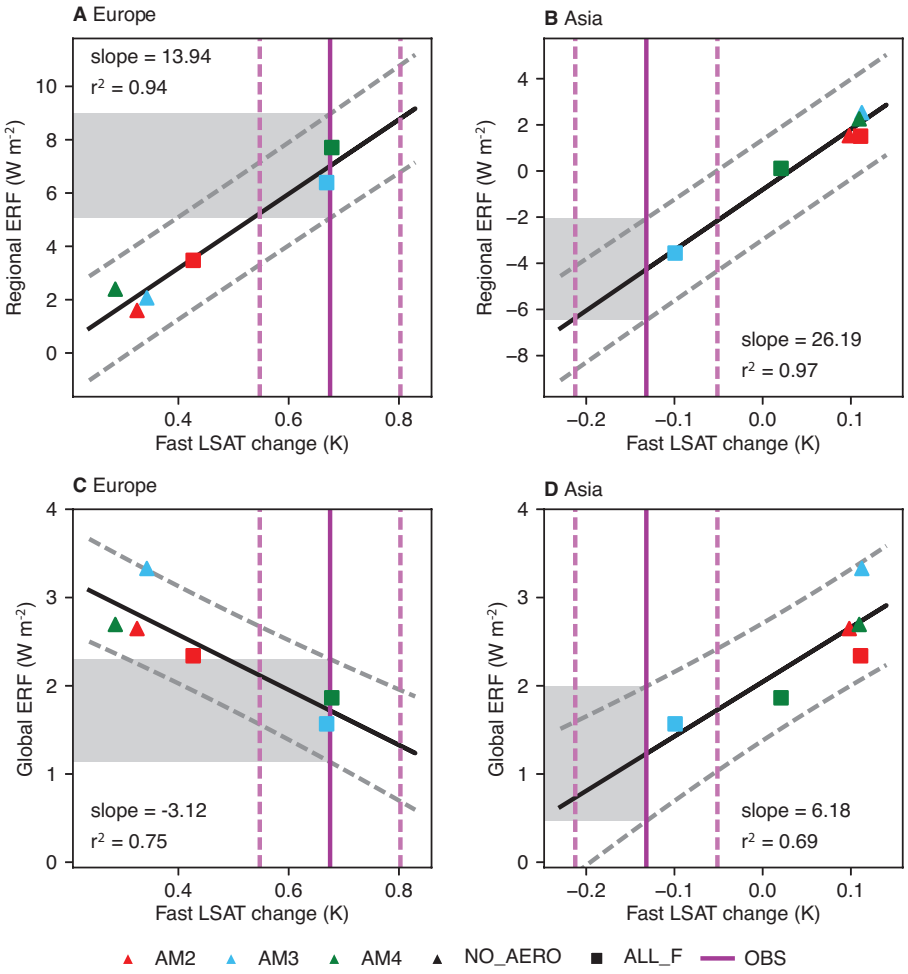

Fig. S4. **Emergent constraints for regional and global ERF for JJAS.** Scatter plots of the fast recent JJAS LSAT changes versus regional ERF (A and B) or global ERF (C and D) over Europe (A and C) and Asia (B and D). AM2 is in red, AM3 in blue and AM4 in green. The triangles and squares represent NO_AERO and ALL_F (after subtracting the corresponding NO_F), respectively. The best linear fits and prediction errors are represented by the black solid and dashed lines, respectively. The vertical purple lines denote the observational estimates (obtained by subtracting the multi-model average LSAT changes in NO_F from the observations): the mean (the solid lines) and the mean plus and minus one standard deviation (the dashed lines). The gray areas delineate the ranges of the inferred regional or global ERF.